

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	:	
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Wang et al.	:	
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Application No. 10/076,881	:	Art Unit: 1764
	:	
Filed: Feb. 13, 2002	:	Examiner: W. Griffin
	:	
For: METHOD AND CATALYST	:	Atty Docket: B-1482-CIP2
STRUCTURE FOR STEAM	:	
REFORMING OF A	:	
HYDROCARBON	:	

RESPONSE TO OFFICE ACTION

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

This is in response to the Office Action mailed March 2, 2006.

It is not believed that extensions of time or fees for net addition of claims are required, beyond those which are otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary, then such extensions of time are hereby petitioned under 37 CFR § 1.136(a); and any fees required for consideration of this paper and any papers associated with it (including fees for net addition of claims) are hereby authorized to be charged to Deposit Account No. 501749.

AMENDMENT

IN THE CLAIMS

No amendments are made in this amendment. The status of all claims is as follows:

1. (previously presented) A method of steam reforming, comprising:
passing steam and hydrocarbon through a reaction chamber;
wherein the reaction chamber comprises a catalyst that has surface active sites comprising a material selected from the group consisting of rhodium, iridium, nickel, palladium, platinum, ruthenium, carbide of group VIb and combinations thereof;
wherein the rate of said passing steam and hydrocarbon is controlled such that contact time in the reaction chamber is less than 0.1 seconds;
wherein, after passing through the reaction chamber, the hydrocarbon conversion has reached at least 50% of equilibrium conversion.
2. (previously presented) The method of claim 1 wherein the reaction chamber comprises a catalyst that has surface active sites comprising a material selected from the group consisting of rhodium, iridium, nickel, palladium, platinum, and combinations thereof.
3. (original) The method of claim 2 wherein the temperature in the reaction chamber is in the range of 500 °C to 1000 °C;
4. (original) The method of claim 2 wherein the catalyst comprises a spinel support.
5. (original) The method of claim 1 wherein the catalyst comprises a zirconia support.
6. (original) The method of claim 3 wherein the catalyst comprises:

a first porous structure with a first pore surface area and a first pore size of at least 0.1 μm ; and

a porous interfacial layer with a second pore surface area and a second pore size that is less than the first pore size.

7. (original) The method of claim 6 wherein the porous interfacial layer comprises a spinel.

8. (original) The method of claim 6 wherein the first porous structure comprises a metal foam or metal felt, and the porous interfacial layer comprises alumina.

9. (original) The method of claim 1 wherein the catalyst has a pore volume of 30 to 95% and at least 50% of the catalyst's pore volume is composed of pores in the size range of 0.3 to 200 microns.

10. (original) The method of claim 3 wherein the hydrocarbon is converted to at least 90% of equilibrium conversion and hydrogen selectivity is at least 85%.

11. (original) The method of claim 10 wherein the catalyst comprises surface active sites comprising Rh.

12. (original) A method of steam reforming, comprising:
passing steam and hydrocarbon through a reaction chamber;
wherein the reaction chamber comprises a catalyst;
wherein the catalyst comprises:

a first porous structure with a first pore surface area and a first pore size of at least 0.1 μm ;

a porous interfacial layer with a second pore surface area and a second pore size that is less than the first pore size; and

a catalyst metal.

13. (original) The method of claim 12 wherein the rate of said passing steam

and hydrocarbon is controlled such that residence time in the reaction chamber is less than about 0.1 seconds;

wherein at least 50% of said hydrocarbon has been converted to products after passing through the reaction chamber.

14. (original) The method of claim 13 wherein the catalyst that has surface active sites comprising a material selected from the group consisting of rhodium, iridium, nickel, palladium, platinum, and combinations thereof.

15. (previously presented) The method of claim 13 wherein the porous interfacial layer comprises a material selected from the group consisting of alumina and spinel.

16. (original) A method of steam reforming, comprising:
passing steam and hydrocarbon through a reaction chamber;
wherein the reaction chamber comprises a catalyst;
wherein the catalyst comprises:
catalyst has a pore volume of 30 to 95% and at least 50% of the catalyst's pore volume is composed of pores in the size range of 0.3 to 200 microns; and
a catalyst metal.

17. (original) The method of claim 12 wherein the rate of said passing steam and hydrocarbon is controlled such that contact time in the reaction chamber is in the range of 5 to 100 milliseconds; and
wherein, after passing through the reaction chamber, the hydrocarbon conversion has reached at least 50% of equilibrium conversion.

18. (original) The method of claim 16 wherein the catalyst has a hydrogen productivity of at least $0.7 \text{ mmol} \cdot \text{s}^{-1} \cdot \text{cm}^{-3}$.

19. (original) The method of claim 11 having a hydrogen productivity of between 0.5 and $2 \text{ mmol} \cdot \text{s}^{-1} \cdot \text{cm}^{-3}$ at a contact time of 10 to 25 msec.

20. (original) The method of claim 11 wherein the hydrocarbon comprises a synthetic fuel made by the Fischer-Tropsch process and wherein, after passing through the reaction chamber, the hydrocarbon conversion has reached at least 70% of equilibrium conversion.

21. (previously presented) The method of claim 4 wherein the spinel support is in the form of a spinel layer disposed over a high surface area material.

22. (previously presented) The method of claim 21 wherein the high surface area material comprises gamma alumina.

23. (previously presented) The method of claim 16 wherein the catalyst comprises a spinel coating.

24. (previously presented) The method of claim 23 wherein the spinel coating is disposed over a high surface area material.

25. (previously presented) The method of claim 16 wherein the hydrocarbon has a contact time of 5-100 ms with the catalyst.

26. (previously presented) The method of claim 2 where the contact time in the reaction chamber is 10 to 25 ms.

27. (previously presented) The method of claim 4 where the contact time in the reaction chamber is 5 to 100 ms.

28. (previously presented) The method of claim 2 where the hydrocarbon consists essentially of methane.

29. (previously presented) The method of claim 4 where the hydrocarbon comprises methane.

30. (previously presented) The method of claim 13 where the hydrocarbon comprises methane.

31. (previously presented) The method of claim 15 where the porous interfacial layer comprises spinel or zirconia and the temperature in the reaction chamber is in the range of 500° to 1000°C.

32. (previously presented) The method of claim 4 wherein the temperature in the reaction chamber is at least 650 °C.

33. (previously presented) The method of claim 2 wherein the absolute conversion is at least 90%.

34. (previously presented) The method of claim 2 wherein the equilibrium conversion is at least 95%.

35. (previously presented) The method of claim 14 wherein the absolute conversion is at least 90%.

36. (previously presented) The method of claim 31 wherein the equilibrium conversion is at least 90%.

37. (previously presented) The method of claim 36 wherein the contact time is 5 to 100 ms.

38. (previously presented) The method of claim 1 wherein H_2 selectivity is at least 60%.

39. (previously presented) The method of claim 17 wherein H_2 selectivity is at least 50%.

40. (previously presented) The method of claim 18 wherein H_2 selectivity is at least 60%.

41. (previously presented) The method of claim 2 wherein H_2 selectivity is at least 85%.

42. (previously presented) The method of claim 33 wherein H₂ selectivity is at least 95%.
43. (previously presented) The method of claim 27 wherein the catalyst possesses a H₂ productivity of at least 0.7 mmol·s⁻¹·cm⁻³.
44. (previously presented) The method of claim 43 wherein the hydrocarbon comprises methane.
45. (previously presented) The method of claim 3 wherein the H₂ productivity is 0.5 to 2 mmol catalyst·s⁻¹·cm⁻³.
46. (previously presented) The method of claim 27 wherein the H₂ productivity is 0.5 to 2 mmol catalyst·s⁻¹·cm⁻³.
47. (previously presented) The method of claim 3 wherein the catalyst comprises a zirconia support.
48. (previously presented) The method of claim 13 wherein the porous interfacial layer comprises zirconia.

49. (previously presented) The method of claim 1 wherein the catalyst has a corrugated form.

50. (previously presented) The method of claim 3 wherein the catalyst is disposed in the reaction chamber such that a gap is provided for flow past the catalyst.

51. (previously presented) The method of claim 50 wherein the reaction chamber is defined by a reaction chamber wall or reaction chamber walls, and wherein the catalyst is in close contact with a reaction chamber wall.

52. (previously presented) The method of claim 12 wherein the catalyst is disposed in the reaction chamber such that a gap is provided for flow past the catalyst.

53. (previously presented) The method of claim 1 wherein the hydrocarbon consists essentially of $C_1 - C_{10}$ alkanes; wherein hydrocarbon equilibrium conversion is at least 90% and H_2 selectivity is at least 60%.

54. (previously presented) The method of claim 53 wherein hydrocarbon equilibrium conversion is at least 99%, and wherein the reaction is conducted at a temperature in the range of 650-885 °C.

55. (previously presented) The method of claim 53 wherein the hydrocarbon consists essentially of methane; wherein hydrocarbon equilibrium conversion is at least 99% and H₂ selectivity is 100%.

56. (previously presented) The method of claim 4 wherein the hydrocarbon consists essentially of C₁ – C₁₀ alkanes; wherein hydrocarbon equilibrium conversion is at least 90% and H₂ selectivity is at least 60%.

57. (previously presented) The method of claim 56 wherein hydrocarbon equilibrium conversion is at least 99%, wherein the surface active sites comprise Rh, and wherein the reaction is conducted at a temperature in the range of 650-885 °C.

58. (previously presented) The method of claim 56 wherein the hydrocarbon consists essentially of methane; wherein hydrocarbon equilibrium conversion is at least 99% and H₂ selectivity is 100%.

REMARKS

Claims 1-58 are pending. There are no amendments submitted with this response.

Claims 1-4, 6-46, and 49-58 have been provisionally rejected on the ground of obviousness-type double patenting over claims 1-8 of copending application ser. no. 10/778904. Because the cited copending application is not near allowance, this provisional rejection should be withdrawn in favor of allowance of all claims. According to the PAIR system, as of June 1, 2006, there has not been a first Office Action in copending application ser. no. 10/778904. Furthermore, copending application ser. no. 10/778904 was filed more than one year after the publication of this application; therefore, the claims in 10/778904 cannot issue if they are obvious in view of this application. Finally, according to MPEP § 804.1.B, a provisional double patenting rejection should not be maintained if it is the only remaining ground of rejection; and because, in this case, it is the only remaining ground of rejection, it should be withdrawn.

Accordingly, withdrawal of the provisional, obviousness-type double patenting rejection in favor of allowance of all claims is respectfully requested.

Conclusion

If the Examiner has any questions or would like to speak to Applicants' representative, the Examiner is encouraged to call Applicants' attorney at the number provided below.

Respectfully submitted,

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